DATA SHEET

TDA9820
Multistandard/dual channel TV FM intercarrier sound demodulator

Product specification
Supersedes data of March 1991
File under Integrated Circuits, IC02

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Philips Semiconductors

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Multistandard/dual channel TV FM intercarrier sound demodulator

TDA9820

FEATURES

- Multistandard application for sound standards M, B/G, I and D/K
- Two alignment-free PLL FM demodulators
- Four-input source selector for one of the two FM demodulators
- Automatic second sound carrier mute
- Mono and dual channel application
- Low power consumption
- Few external components required.

GENERAL DESCRIPTION

The TDA9820 is a monolithic, integrated, multistandard TV FM intercarrier sound demodulator for all FM standards. The circuit contains two separate FM demodulators using Phase Locked Loop (PLL) reference frequency generation. The circuit requires a minimum number of external components.

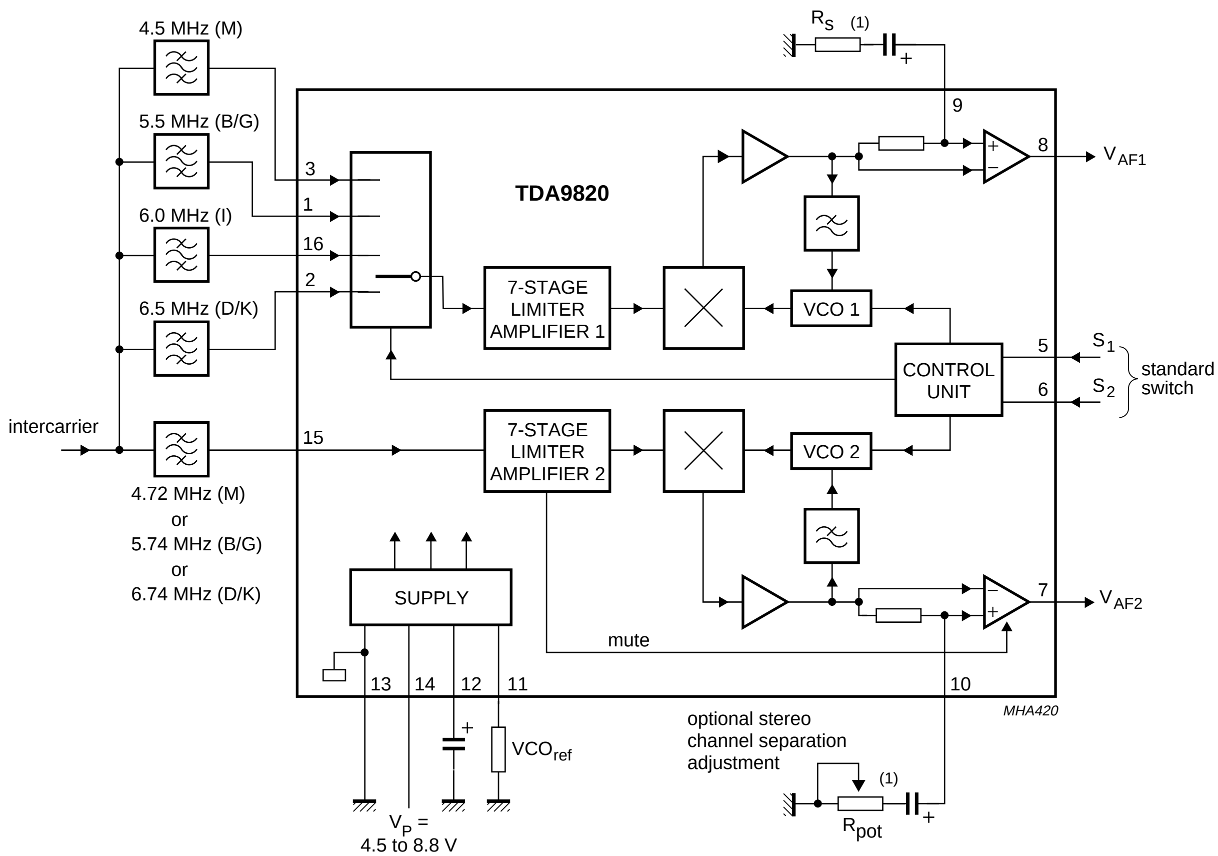
QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_P	supply voltage (pin 14)		4.5	5.0	8.8	V
I_P	supply current (pin 14)		23	30	37	mA
I_M	AC peak current (pins 7 and 8)		–	–	1.5	mA
$V_{i(rms)}$	input signal (RMS value)	$\frac{S+N}{N} = 40$ dB	–	150	250	μV
$V_{o(rms)}$	output signal (pins 7 and 8; RMS value)	$\Delta f_i = \pm 50$ kHz	0.4	0.5	0.6	V
$\frac{S+N}{N}$	signal plus noise-to-noise ratio (pins 7 and 8)	in accordance with *“CCIR 468-3”*	64	68	–	dB
$\alpha_{8/7}$	crosstalk attenuation	f = 50 to 12 500 Hz	60	70	–	dB
RR	supply voltage ripple rejection (pins 7 and 8)	V_{RR} < 200 mV; f = 70 Hz	16	20	–	dB
T_{amb}	operating ambient temperature		0	–	70	°C

ORDERING INFORMATION

TYPE NUMBER	PACKAGE		
	NAME	DESCRIPTION	VERSION
TDA9820	DIP16	plastic dual in-line package; 16 leads (300 mil); long body	SOT38-1
TDA9820T	SO16	plastic small outline package; 16 leads; body width 7.5 mm	SOT162-1

BLOCK DIAGRAM



(1) Resistor and potentiometer between capacitor and earth are inserted if adjustment of stereo channel separation is required.

Fig.1 Block diagram.

PINNING

SYMBOL	PIN	DESCRIPTION
$IN_{1(B/G)}$	1	intercarrier input 1 at 5.5 MHz
$IN_{1(D/K)}$	2	intercarrier input 1 at 6.5 MHz
$IN_{1(M)}$	3	intercarrier input 1 at 4.5 MHz
n.c.	4	not connected
S_1	5	standard switch bit 1 input
S_2	6	standard switch bit 2 input
V_{AF2}	7	audio output voltage 2
V_{AF1}	8	audio output voltage 1
C_1	9	decoupling capacitor 1
C_2	10	decoupling capacitor 2
VCO_{ref}	11	VCO reference
C_{STAB}	12	supply voltage stabilization
GND	13	ground
V_P	14	supply voltage
IN_2	15	intercarrier input 2
$IN_{1(I)}$	16	intercarrier input 1 at 6.0 MHz

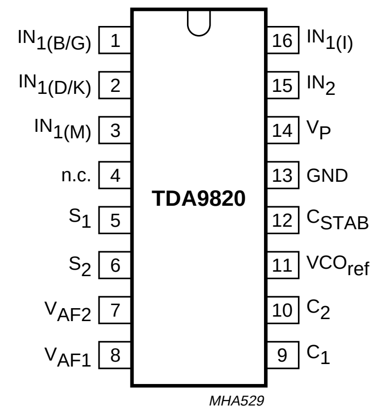


Fig.2 Pin configuration.

FUNCTIONAL DESCRIPTION

The complete circuit consists of two separate channels, each consisting of a limiter-amplifier, FM demodulator and AF amplifier. Circuit operation is also described in Fig.1.

Source selector

The intercarrier signal is fed through external ceramic band-pass filters which are tuned to the sound carrier frequencies.

One of the four filtered sound carriers from pins 1, 2, 3 or 16 is fed to limiter-amplifier 1 via the appropriate electronic switch in the source selector. The electronic switch of the sound carrier is selected by the control unit (see Table 1).

The second sound carrier of the intercarrier signal is directly fed from pin 15 to limiter-amplifier 2.

FM demodulators

Each limiter-amplifier is AC-coupled into a FM demodulator. The integrated FM demodulator PLLs are alignment-free. The FM demodulator outputs are amplified to 500 mV (RMS value). High amplification and DC error signals of the PLLs, which are superimposed on the FM demodulator outputs, require DC decoupling at pins 9 and 10 of the AF amplifier inputs.

Stereo channel separation adjustment (optional)

Optimal stereo channel separation is achieved by adjusting V_{AF1} (pin 8) and V_{AF2} (pin 7) as follows:

1. V_{AF1} by a resistor in series with the DC decoupling capacitor at pin 9
2. V_{AF2} by a variable resistor in series with the DC decoupling capacitor on pin 10 to the same voltage as V_{AF1}.

Second sound carrier mute

The output of the second FM demodulator is muted when the signal level (signal and/or noise) at pin 15 is less than typically 0.5 mV (RMS value). This avoids an incorrect stereo or dual sound identification when a mono signal is transmitted. Therefore, with a mono transmission, there is no audio output at pin 7. When the signal level at pin 15 is greater than typically 1.0 mV (RMS value) mute is switched off.

Control unit

The control unit selects the required sound standard according to the voltages on pin 5 and pin 6. The control unit performs the following:

1. selects the free-running frequencies of VCO1 and VCO2
2. switches the source selector (the four possible combinations are shown in Table 1).

Table 1 Logic table; note 1

STANDARD	S1 (PIN 5)	S2 (PIN 6)	FREQUENCY VCO1 (MHz)	FREQUENCY VCO2 (MHz)	SOURCE SELECTOR CONNECTION
B/G	1	1	5.5	5.74	pin 1
M	1	0	4.5	4.72	pin 3
I	0	1	6.0	off	pin 16
D/K	0	0	6.5	6.74	pin 2

Note

1. In columns S1 and S2: 0 = LOW and 1 = HIGH.

LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_P	supply voltage (pin 14)		–0.5	+9.0	V
V_i	input signal (pins 1, 2, 3, 15 and 16)		–0.5	+5.0	V
V_{sw}	switching voltage (pins 5 and 6)		–0.5	V_P + 0.5	V
t_s	short-circuit time (each pin except pins 13 and 14 to be tested; one at the time)		–	10	s
T_{stg}	storage temperature				
	device		–25	+125	°C
	device in packing		–25	+85	°C
T_j	junction temperature		–	150	°C
T_{amb}	operating ambient temperature		0	70	°C
V_{es}	electrostatic handling for all pins	note 1	–500	+500	V
		note 2	–4000	+4000	V

Notes

1. Equivalent to discharging a 200 pF capacitor via a 0 Ω series resistor.
2. Equivalent to discharging a 100 pF capacitor via a 1.5 kΩ series resistor.

THERMAL CHARACTERISTICS

SYMBOL	PARAMETER	VALUE	UNIT
$R_{th\ j\text{-}a}$	thermal resistance from junction to ambient in free air		
	TDA9820 (DIP16)	74	K/W
	TDA9820T (SO16)	104	K/W

CHARACTERISTICS

All voltages are measured to GND (pin 13); V_P = 5 V; T_{amb} = 25 °C; Δf_i = ±50 kHz; f_{mod} = 1 kHz; $V_{1, 2, 3, 16/15}$ = 10 mV (RMS value); measurements taken in Fig.5; unless otherwise specified.

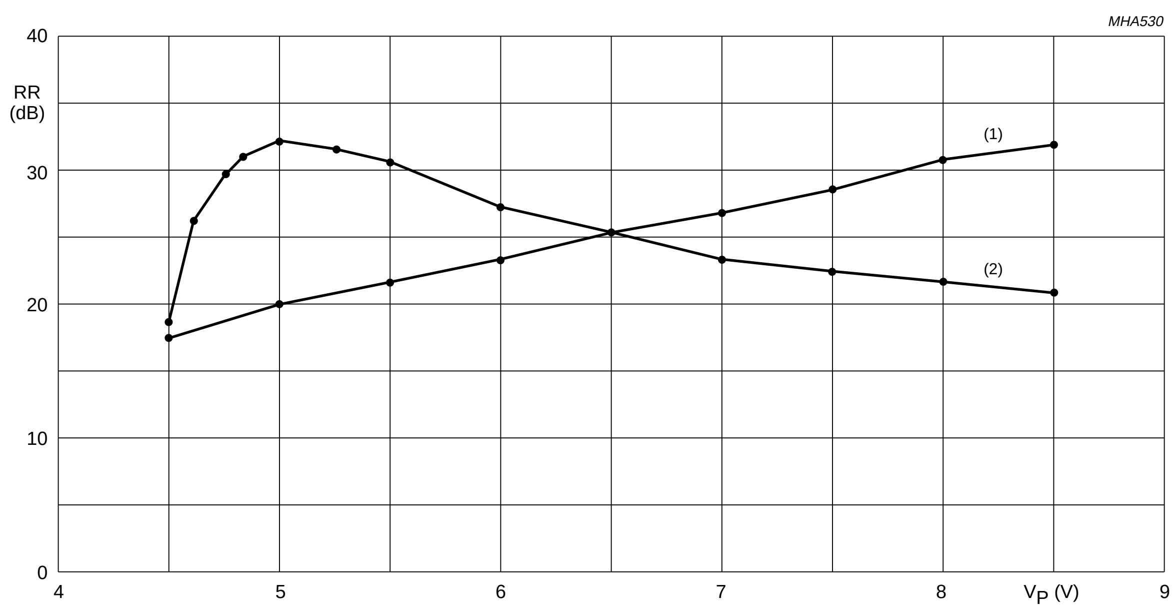
SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Supply (pin 14)						
V_P	supply voltage		4.5	5.0	8.8	V
I_P	supply current		23	30	37	mA
Source selector and limiter-amplifier 1 (pins 1, 2, 3 and 16)						
V_I	DC input voltage	activated input	2.25	2.5	2.75	V
		not activated input	–	–	0.1	V
R_I	input resistance	activated input	480	600	720	Ω
		not activated input	–	–	600	Ω
$V_{i(rms)}$	input signal (RMS value)	$\frac{S+N}{N}$ = 40 dB	–	150	250	μV
	allowed input signal (RMS value)		200	–	–	mV
α_{ct}	crosstalk attenuation	not activated input to activated input	40	50	–	dB
Limiter-amplifier 2						
V_{15}	DC input voltage		2.25	2.5	2.75	V
$V_{15(rms)}$	input signal (RMS value)	$\frac{S+N}{N}$ = 40 dB ; note 1	–	150	250	μV
	input signal for mute off (RMS value)		0.7	1.0	1.5	mV
	allowed input signal (RMS value)		200	–	–	mV
R_{15}	input resistance		480	600	720	Ω
δ	hysteresis of level detector		8	12	16	dB
PLL FM demodulators VCO1 and VCO2						
f_{VCO1}	free-running frequencies	R_{11} = 27 kΩ; see Table 1	–	4.5	–	MHz
			–	5.5	–	MHz
			–	6.0	–	MHz
			–	6.5	–	MHz
f_{VCO2}	free-running frequencies	R_{11} = 27 kΩ; see Table 1	–	4.7	–	MHz
			–	5.7	–	MHz
			–	6.7	–	MHz
Δf_{fr}	negative/positive free-running frequency spread		–	–	10	%
$D/\Delta f_{fr}$	drift of free-running frequencies	T_{amb} = 0 to 70 °C	–	500	750	kHz
$\Delta f_{fr(shift)}$	shift of free-running frequencies	4.5 V < V_P < 8.8 V	–	200	300	kHz
$\Delta f_{fr(ar)}$	negative/positive adjustment range of free-running frequencies	R_{11} = 22 kΩ	1	–	–	MHz
R_{11}	adjustment resistance for free-running frequencies (pin 11)		15	–	29	kΩ

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
S	negative slope of free-running frequency adjustment	R_{11} = 22 kΩ	–	200	–	kHz/kΩ
Δf1	negative/positive catching range of PLLs		1.4	1.9	–	MHz
Δf2	negative/positive holding range of PLLs		2.0	3.0	–	MHz
Output amplifiers AF1 (pin 8) and AF2 (pin 7)						
V_O	DC output voltage		1.8	2.1	2.5	V
$V_{o(rms)}$	output signal (RMS value)		0.4	0.5	0.6	V
		clipping level	1.2	–	–	V
I_M	AC peak current		–	–	1.5	mA
I_O	DC source current		–	–	2.0	mA
$\Delta V_o/V_o$	absolute drift of AF output signals	T_{amb} = 0 to 70 °C	–	0.7	–	dB
$\Delta V_{o1}/\Delta V_{o2}$	relative drift of AF output signals	T_{amb} = 0 to 70 °C	–	0.2	–	dB
$\Delta V_{AF(1-2)}$	negative/positive difference between output signals	50 μs de-emphasis	–	0.3	1.0	dB
R_o	output resistance		–	100	150	Ω
$\alpha_{cs(ar)}$	adjustment range of channel separation	R_s = 1.1 kΩ; R_{pot} = 2.2 kΩ	1.5	–	–	dB
THD	total harmonic distortion	50 μs de-emphasis				
		pin 8	–	0.1	0.3	%
		pin 7	–	0.25	0.5	%
α_{AM}	AM suppression of AF(1-2)	50 μs de-emphasis; m = 0.3; f_{AM} = 1 kHz	46	66	–	dB
$\frac{S+N}{N}$	signal plus noise-to-noise ratio	50 μs de-emphasis; in accordance with *"CCIR 468-3"*	64	68	–	dB
AF_{resp}	LOW-level AF frequency response	$\Delta V_{AF(1-2)}$ = –3 dB	–	–	20	Hz
	HIGH-level AF frequency response		200	–	–	kHz
$AM_{res(rms)}$	residual sound carrier signal and harmonics (RMS value)		–	50	80	mV
$\alpha_{8/7}$	crosstalk attenuation between AF outputs	f = 50 to 12500 Hz	60	70	–	dB
RR	supply voltage ripple rejection	V_{RR} < 200 mV; f_r = 20 Hz to 200 kHz				
		V_P = 5 V	16	20	–	dB
		V_P = 8 V	24	28	–	dB
RR	supply voltage ripple rejection with improved application for V_P = 5 V	f_r = 20 Hz to 3 kHz; see Fig.3 and note 2				
		V_P = 4.5 V	18	24	–	dB
		V_P = 4.75 V	21	27	–	dB
		V_P = 5.0 V	24	30	–	dB
		V_P = 5.5 V	21	27	–	dB

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Control unit; see Table 1						
$V_{5,6}$	voltage for LOW level		0	–	0.8	V
$I_{5,6}$	source current for LOW level	$0 < V_{5,6} < 0.8$	–	180	250	μA
$R_{5,6}$	allowed resistance to ground	$0 < V_{5,6} < 0.8$ (LOW-level)	–	–	3.0	kΩ
V_5	voltage for HIGH level	note 3	2.2	–	V_P	V
V_6	voltage for HIGH level	note 3	1.8	–	V_P	V
$I_{5,6}$	sink current for HIGH level	$V_{5,6} = V_P$	–	–	10	μA

Notes

1. The output signal at pin 7 can only be measured when mute is disabled. This is achieved by inserting a resistor of 2.7 kΩ between pin 15 and ground. In this event the input impedance is 490 Ω.
2. Improvement of ripple rejection is possible by connecting series RC between pin 11 and pin 14 (15 kΩ + 2.2 μF; see Fig.5) for a supply voltage of 4.5 to 5.5 V. The rejection of ripple frequencies up to 3 kHz is improved, but up to 200 kHz is worse; see Fig.3.
3. An open pin (n.c.) is interpreted as HIGH.



The curves are typical and valid for ripple frequencies between 50 Hz and 3 kHz.

Conditions: input signal: f = 5.5 MHz, 10 mV (RMS value); ripple on V_P = 100 mV (RMS value), f_r = 1 kHz; ripple rejection measurement: unweighted RMS.

(1) Without RC.

(2) With R = 15 kΩ and C = 2.2 μF.

Fig.3 Typical improvement.

INTERNAL CIRCUITRY

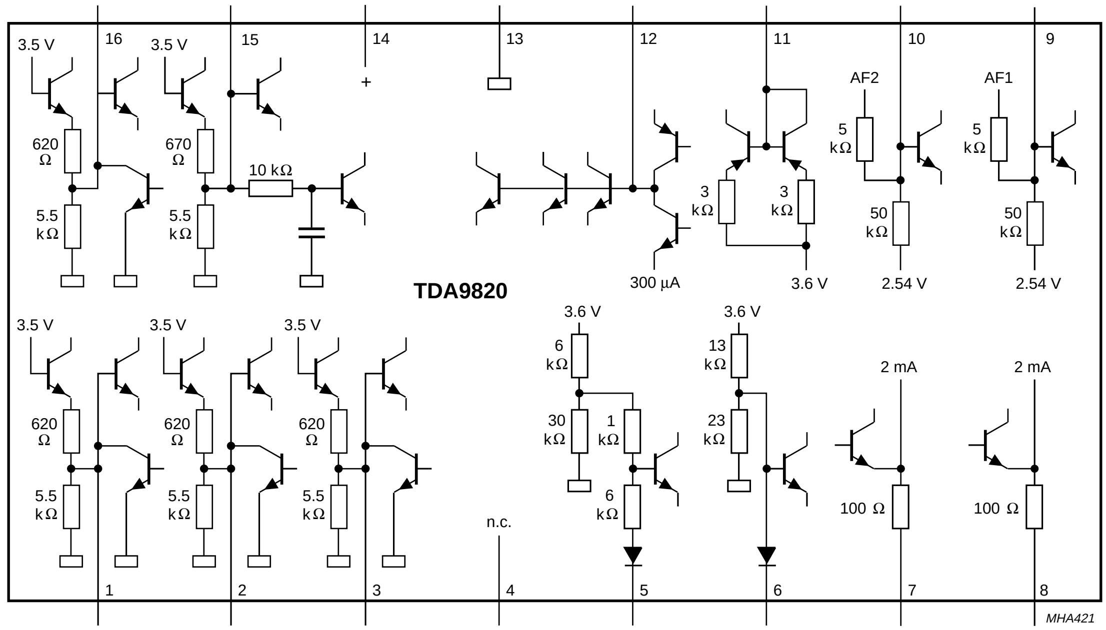
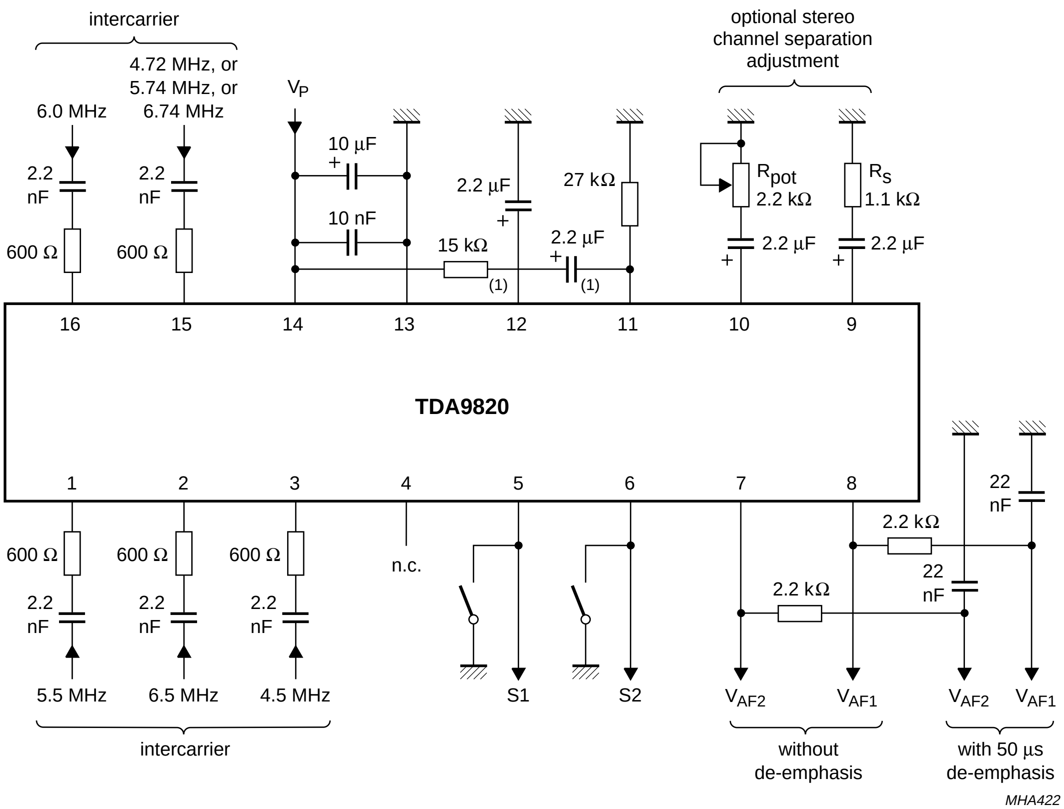


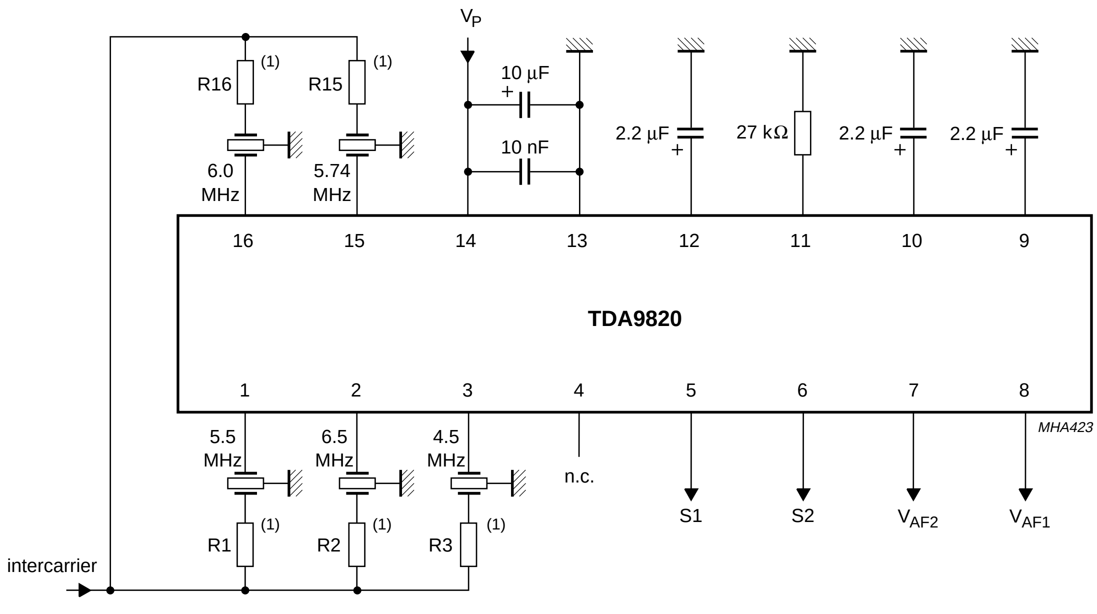
Fig.4 Internal circuitry.

TEST AND APPLICATION INFORMATION



(1) See note 2 of Chapter “Characteristics”.

Fig.5 Test circuit.

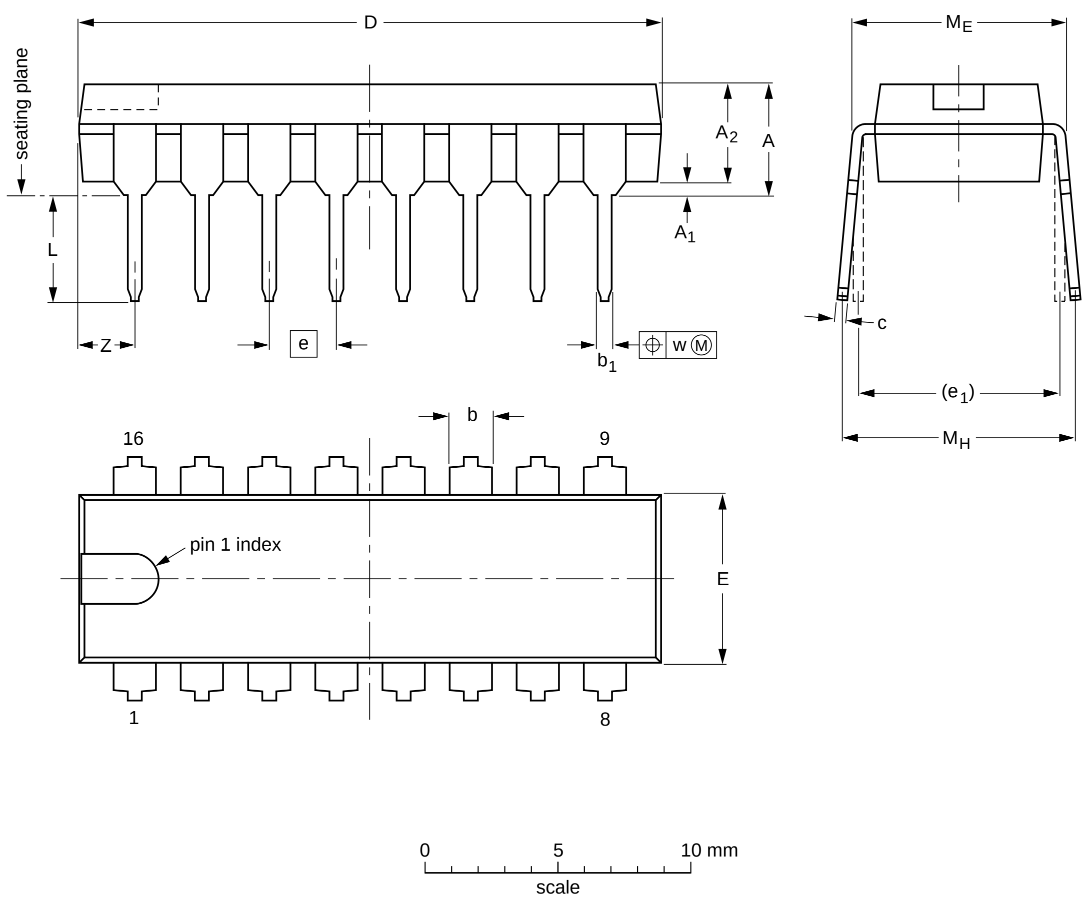


(1) Resistor value depends on filter.

Fig.6 Application circuit.

PACKAGE OUTLINES

DIP16: plastic dual in-line package; 16 leads (300 mil); long body SOT38-1

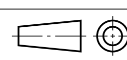


DIMENSIONS (inch dimensions are derived from the original mm dimensions)

UNIT	A max.	A_1 min.	A_2 max.	b	b_1	c	D (1)	E (1)	e	e_1	L	M_E	M_H	w	Z (1) max.
mm	4.7	0.51	3.7	1.40 1.14	0.53 0.38	0.32 0.23	21.8 21.4	6.48 6.20	2.54	7.62	3.9 3.4	8.25 7.80	9.5 8.3	0.254	2.2
inches	0.19	0.020	0.15	0.055 0.045	0.021 0.015	0.013 0.009	0.86 0.84	0.26 0.24	0.10	0.30	0.15 0.13	0.32 0.31	0.37 0.33	0.01	0.087

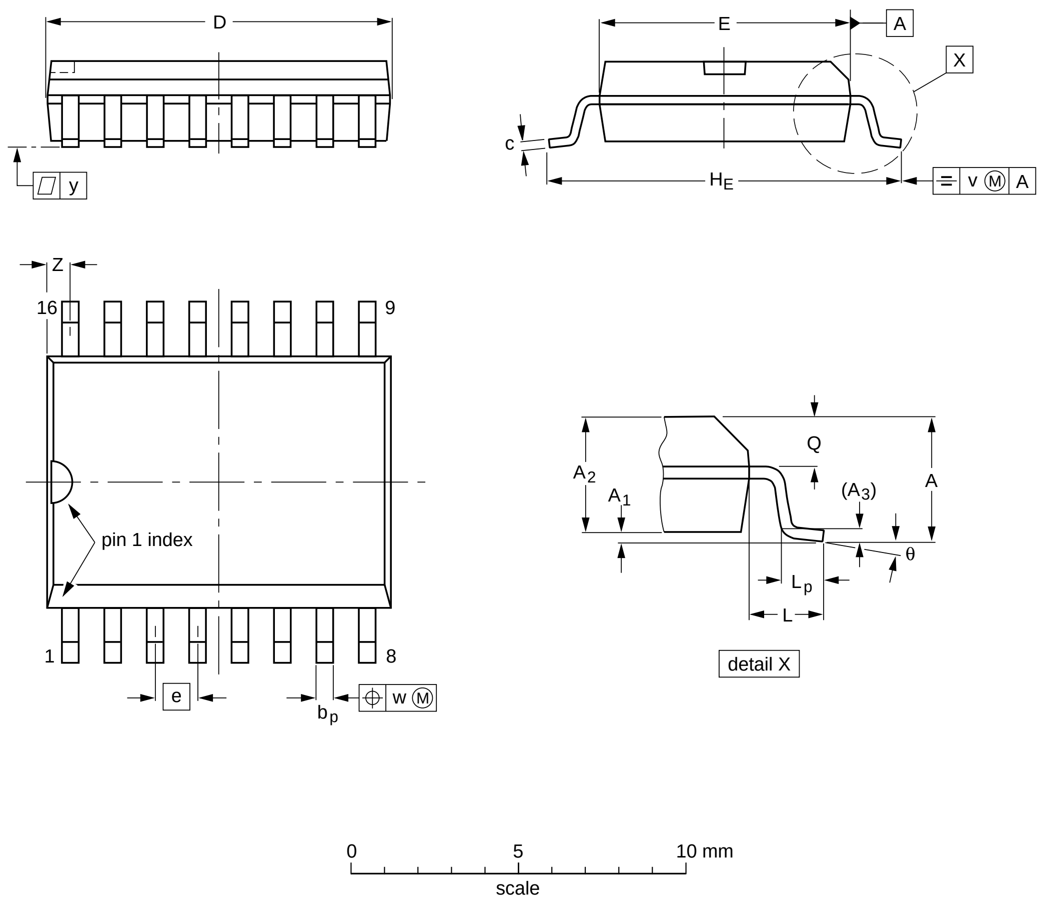
Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT38-1	050G09	MO-001AE				~~92-10-02~~ 95-01-19

PACKAGE OUTLINE

SO16: plastic small outline package; 16 leads; body width 7.5 mm **SOT162-1**

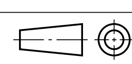


DIMENSIONS (inch dimensions are derived from the original mm dimensions)

UNIT	A max.	A_1	A_2	A_3	b_p	c	D [(1)]	E [(1)]	e	H_E	L	L_p	Q	v	w	y	Z [(1)]	θ
mm	2.65	0.30 0.10	2.45 2.25	0.25	0.49 0.36	0.32 0.23	10.5 10.1	7.6 7.4	1.27	10.65 10.00	1.4	1.1 0.4	1.1 1.0	0.25	0.25	0.1	0.9 0.4	8° 0°
inches	0.10	0.012 0.004	0.096 0.089	0.01	0.019 0.014	0.013 0.009	0.41 0.40	0.30 0.29	0.050	0.42 0.39	0.055	0.043 0.016	0.043 0.039	0.01	0.01	0.004	0.035 0.016	

Note

1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT162-1	075E03	MS-013AA				~~92-11-17~~ 95-01-24

SOLDERING

Introduction

There is no soldering method that is ideal for all IC packages. Wave soldering is often preferred when through-hole and surface mounted components are mixed on one printed-circuit board. However, wave soldering is not always suitable for surface mounted ICs, or for printed-circuits with high population densities. In these situations reflow soldering is often used.

This text gives a very brief insight to a complex technology. A more in-depth account of soldering ICs can be found in our *"IC Package Databook"* (order code 9398 652 90011).

DIP

SOLDERING BY DIPPING OR BY WAVE

The maximum permissible temperature of the solder is 260 °C; solder at this temperature must not be in contact with the joint for more than 5 seconds. The total contact time of successive solder waves must not exceed 5 seconds.

The device may be mounted up to the seating plane, but the temperature of the plastic body must not exceed the specified maximum storage temperature ($T_{stg\,max}$). If the printed-circuit board has been pre-heated, forced cooling may be necessary immediately after soldering to keep the temperature within the permissible limit.

REPAIRING SOLDERED JOINTS

Apply a low voltage soldering iron (less than 24 V) to the lead(s) of the package, below the seating plane or not more than 2 mm above it. If the temperature of the soldering iron bit is less than 300 °C it may remain in contact for up to 10 seconds. If the bit temperature is between 300 and 400 °C, contact may be up to 5 seconds.

SO

REFLOW SOLDERING

Reflow soldering techniques are suitable for all SO packages.

Reflow soldering requires solder paste (a suspension of fine solder particles, flux and binding agent) to be applied to the printed-circuit board by screen printing, stencilling or pressure-syringe dispensing before package placement.

Several techniques exist for reflowing; for example, thermal conduction by heated belt. Dwell times vary between 50 and 300 seconds depending on heating method. Typical reflow temperatures range from 215 to 250 °C.

Preheating is necessary to dry the paste and evaporate the binding agent. Preheating duration: 45 minutes at 45 °C.

WAVE SOLDERING

Wave soldering techniques can be used for all SO packages if the following conditions are observed:

- A double-wave (a turbulent wave with high upward pressure followed by a smooth laminar wave) soldering technique should be used.
- The longitudinal axis of the package footprint must be parallel to the solder flow.
- The package footprint must incorporate solder thieves at the downstream end.

During placement and before soldering, the package must be fixed with a droplet of adhesive. The adhesive can be applied by screen printing, pin transfer or syringe dispensing. The package can be soldered after the adhesive is cured.

Maximum permissible solder temperature is 260 °C, and maximum duration of package immersion in solder is 10 seconds, if cooled to less than 150 °C within 6 seconds. Typical dwell time is 4 seconds at 250 °C.

A mildly-activated flux will eliminate the need for removal of corrosive residues in most applications.

REPAIRING SOLDERED JOINTS

Fix the component by first soldering two diagonally-opposite end leads. Use only a low voltage soldering iron (less than 24 V) applied to the flat part of the lead. Contact time must be limited to 10 seconds at up to 300 °C. When using a dedicated tool, all other leads can be soldered in one operation within 2 to 5 seconds between 270 and 320 °C.

DEFINITIONS

Data sheet status	
Objective specification	This data sheet contains target or goal specifications for product development.
Preliminary specification	This data sheet contains preliminary data; supplementary data may be published later.
Product specification	This data sheet contains final product specifications.
Limiting values	
Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability.	
Application information	
Where application information is given, it is advisory and does not form part of the specification.	

LIFE SUPPORT APPLICATIONS

These products are not designed for use in life support appliances, devices, or systems where malfunction of these products can reasonably be expected to result in personal injury. Philips customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify Philips for any damages resulting from such improper use or sale.

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